FORM PTO-1390 (REV. 11-2000)	U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		32860-000284/US
		U.S. APPLICATION NO. (If known, see 37 CFR 1.5) 10/088166
INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE00/02522	July 31, 2000	September 16, 1999

TITLE OF INVENTION

CONTROL SYSTEM FOR AN ELECTROMAGNETIC SWITCHING DEVICE AND ELECTROMAGNETIC SWITCHING DEVICE CORRESPONDING THERETO

APPLICANT(S) FOR DO/EO/US

Norbert MITLMEIER and Bernhard STREICH

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39 (1).
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau). WO 01/20630
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☒ is transmitted herewith.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4)
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 20. below concern document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98-1449 and International Search Report (PCT/ISA/210) in German with five (5) references and German translation aid.
12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.
14. ☐ A SECOND or SUBSEQUENT preliminary amendment.
15. ☒ A substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821-1.825.
18. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. ☒ Other items or information:
    1) Two (2) sheets of Formal Drawings

U.S. APPLICATION NO (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
10/088166	PCT/DE00/02522	32860-000284/US

21. ☒ The following fees are submitted	CALCULATIONS	PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5):		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO. **$1,040.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$890.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO. **$710.00**		
International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$690.00**		
International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4). **$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 890.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$ 0	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total Claims	37 - 20 =	17	X **$18.00**	$ 306.00	
Independent Claims	3 - 3 =	0	X **$80.00**	$ 0	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)		None	+ **$270.00**	$ 0	
			TOTAL OF ABOVE CALCULATIONS =	$ 1,196.00	
☐ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.				$ 0	
			SUBTOTAL =	$ 1,196.00	
Processing fee of **$130.00** for furnishing the English translation later than ☐20 ☐30 months from the earliest claimed priority date (37 CFR 1.492(f)).			+	$ 0	
			TOTAL NATIONAL FEE =	$ 1,196.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property			+	$ 40.00	
			TOTAL FEES ENCLOSED =	$ 1,236.00	
				Amount to be: refunded	$
				charged	$

a. ☒ A check in the amount of $ **1,236.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account. No. 08-0750 in the amount of $ to cover the above fees. A triplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 08-0750.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

Send all correspondence to
Harness, Dickey & Pierce, P.L.C – Customer No. 30596
Post Office Box 8910
Reston, Virginia 20195

Date: MARCH 15, 2002

By _____
Donald J. Daley, #34,313

/kna

PATENT
32860-000284/US

IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicants:	Norbert MITLMEIER and Bernhard STREICH
Int'l App. No.:	PCT/DE00/02522
Application No.:	**NEW**
Filed:	March 15, 2002
For:	CONTROL SYSTEM FOR AN ELECTROMAGNETIC SWITCHING DEVICE AND ELECTROMAGNETIC SWITCHING DEVICE CORRESPONDING THERETO

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, DC 20231

March 15, 2002

Sir:

The following preliminary amendments and remarks are respectfully submitted in connection with the above-identified application.

IN THE ABSTRACT

Please replace the Abstract with the attached revised Abstract.

IN THE CLAIMS

Please amend the claims as follows:

1. (Amended) A method for monitoring an electromagnetic switching device at least for the correct connection of an input contact and of an output contact via a contact bridge, the contact bridge being moved from a separated position into a connection position via a bridge drive when a connection command is given and upon determining that the contacts are correctly connected comprising:

coupling, when the connection command is given, a monitoring circuit to the contacts before the contact bridge is moved into the connection position; and

determining an indicator of the correct connection of the contacts by evaluation of a contact voltage dropped across the contacts and supplied to the monitoring circuit.

2. (Amended) The monitoring method as claimed in claim 1, wherein the electromagnetic switching device is also monitored for correct separation of the input contact from the output contact by the contact bridge, further comprising:

moving, if the contacts are correctly separated, the contact bridge from the connection position into the separated position via the bridge drive, when a separating command is given;

decoupling, when a separating command is given, the monitoring circuit from at least one of the contacts after the contact bridge has moved into the separated position; and

determining an indicator of the correct separation of the contacts by evaluation of the contact voltage.

3. (Amended) The monitoring method as claimed in claim 1, further comprising:

rectifying the contact voltage before it is supplied to the monitoring circuit.

4. (Amended) The monitoring method as claimed in claim 1, wherein a preliminary signal, corresponding to the contact voltage, is supplied to an evaluating unit to aid in determining the indicator.

5. (Amended) The monitoring method as claimed in claim 4, wherein the preliminary signal is supplied DC-isolated to the evaluating unit.

6. (Amended) The monitoring method as claimed in claim 1, wherein the electromagnetic switching device is moved into a safe state if the contacts are not correctly connected or separated, respectively.

7. (Amended) The monitoring method as claimed in claim 6, wherein the incorrect connection or separation of the contacts is signaled to a higher-level controller if the contacts are not correctly connected or separated, respectively.

8. (Amended) An electromagnetic switching device, comprising:

at least one input contact;

at least one output contact;

a contact bridge; and

a bridge drive for moving the contact bridge from a separated position to a connection position when a connection command is given, wherein a monitoring circuit is coupleable to the contacts via an auxiliary switch, wherein when a connection command is given, the auxiliary switch is closed before the contact bridge is moved into the connection position, and wherein the monitoring circuit outputs an indicator of the correct connection of the contacts.

9. (Amended) The switching device as claimed in claim 8, wherein the monitoring circuit is decoupleable from at least one of the contacts via the auxiliary switch, wherein when a separating command is given, the auxiliary switch is opened after the contact bridge has been moved into the separated position, and wherein the monitoring circuit outputs an indicator of the correct separation of the contacts.

10. (Amended) The switching device as claimed in claim 8, wherein the monitoring circuit is preceded by a rectifier.

11. (Amended) The switching device as claimed in claim 8, wherein the monitoring circuit includes a contact voltage indicator and an evaluating unit, wherein the contact voltage indicator outputs to the evaluating unit a preliminary signal corresponding to a contact voltage and wherein the evaluating unit uses the preliminary signal to aid in determining the indicator.

12. (Amended) The switching device as claimed in claim 11, wherein the contact voltage indicator is DC-isolated from the evaluating unit.

13. (Amended) The switching device as claimed in claim 9, wherein the monitoring circuit is connected to the bridge drive by control technology.

14. (Amended) The switching device as claimed in claim 8, wherein the monitoring circuit is communicatively connected to a higher-level controller.

Please add the following new claims:

-- 15. The monitoring method as claimed in claim 2, further comprising:

rectifying the contact voltage before it is supplied to the monitoring circuit.

16. The monitoring method as claimed in claim 2, wherein a preliminary signal, corresponding to the contact voltage, is supplied to an evaluating unit to aid in determining the indicator.

17. The monitoring method as claimed in claim 16, wherein the preliminary signal is supplied DC-isolated to the evaluating unit.

18. The monitoring method as claimed in claim 2, wherein the electromagnetic switching device is moved into a safe state if the contacts are not correctly connected or separated, respectively.

19. The monitoring method as claimed in claim 18, wherein the incorrect connection or separation of the contacts is signaled to a higher-level controller if the contacts are not correctly connected or separated, respectively.

20. The switching device as claimed in claim 9, wherein the monitoring circuit is preceded by a rectifier.

21. The switching device as claimed in claim 9, wherein the monitoring circuit includes a contact voltage indicator and an evaluating unit, wherein the contact voltage indicator outputs to the evaluating unit a preliminary signal corresponding to a contact voltage and wherein the evaluating unit uses the preliminary signal to aid in determining the indicator.

22. The switching device as claimed in claim 21, wherein the contact voltage indicator is DC-isolated from the evaluating unit.

23. The switching device as claimed in claim 8, wherein the monitoring circuit is connected to the bridge drive by control technology.

24. The switching device as claimed in claim 9, wherein the monitoring circuit is communicatively connected to a higher-level controller.

25. The method of claim 1, wherein the electromagnetic switching device is a circuit breaker.

26. The method of claim 2, wherein the electromagnetic switching device is a circuit breaker.

27. The device of claim 8, wherein the electromagnetic switching device is a circuit breaker.

28. The device of claim 9, wherein the electromagnetic switching device is a circuit breaker.

29. The device of claim 8, wherein the electromagnetic switching device includes the auxiliary switch.

30. The device of claim 9, wherein the electromagnetic switching device includes the auxiliary switch.

31. A monitoring circuit, coupleable to input and output contacts of an electromagnetic switching device, comprising:

a contact voltage indicator; and

an evaluating unit, wherein the monitoring circuit is coupleable to the contacts when a connection command is given and before a contact bridge of the electromagnetic switching device is moved from a separated position to a connection position, wherein the contact voltage indicator outputs a preliminary signal to the evaluation unit corresponding to a contact voltage, and wherein the evaluation unit uses the preliminary signal to aid in determining an indicator of correct connection of the contacts, such that the contact bridge is moved from a separated position to a connection position upon determining that the contacts are correctly connected.

32. The monitoring circuit of claim 31, wherein the monitoring circuit is coupleable to the contacts via an auxiliary switch.

33. The monitoring circuit as claimed in claim 32, wherein the monitoring circuit is decoupleable from at least one of the contacts via the auxiliary switch, wherein when a separating command is given, the auxiliary switch is opened after the contact bridge has been moved into the separated position, and wherein the monitoring circuit outputs an indicator of the correct separation of the contacts.

34. The monitoring circuit as claimed in claim 33, wherein the monitoring circuit is preceded by a rectifier.

35. The monitoring circuit as claimed in claim 31, wherein the contact voltage indicator is DC-isolated from the evaluating unit.

36. The monitoring circuit of claim 31, wherein a bridge drive moves the contact bridge and wherein the monitoring circuit is connected to the bridge drive by control technology.

37. The monitoring circuit of claim 31, wherein a bridge drive moves the contact bridge and wherein the monitoring circuit is communicatively connected to a higher-level controller.

REMARKS

Claims 1-37 are now present in this application, with new claims 15-37 being added by the present Preliminary Amendment. It should be noted that the amendments to original claims 1-14 of the present application are non-narrowing amendments, made solely to place the claims in proper form for U.S. practice and not to overcome any prior art or for any other statutory considerations. For example, amendments have been made to broaden the claims; remove reference numerals in the claims; remove the European phrase "characterized in that"; remove multiple dependencies in the claims; and to place claims in a more recognizable U.S.

form, including the use of the transitional phrase "comprising" as well as the phrase "wherein". Other such non-narrowing amendments include placing apparatus-type claims (setting elements forth in separate paragraphs) and method-type claims (beginning elements, set forth in separate paragraphs with "-ing" verbs) in a more recognizable U.S. form. Again, all amendments are non-narrowing and have been made solely to place the claims in proper form for U.S. practice and not to overcome any prior art or for any other statutory considerations.

SUBSTITUTE SPECIFICATION

In accordance with 37 C.F.R. §1.125, a substitute specification has been included in lieu of substitute paragraphs in connection with the present Preliminary Amendment. The substitute specification is submitted in clean form, attached hereto, and is accompanied by a marked-up version showing the changes made to the original specification. The changes have been made in an effort to place the specification in better form for U.S. practice. No new matter has been added by these changes to the specification. Further, the substitute specification includes paragraph numbers to facilitate amendment practice as requested by the U.S. Patent and Trademark Office.

CONCLUSION

Accordingly, in view of the above amendments and remarks, an early indication of the allowability of each of claims 1-37 in connection with the present application is earnestly solicited.

Should there be any outstanding matters that need to be resolved in the present

application, the Examiner is respectfully requested to contact Donald J. Daley at the telephone number of the undersigned below.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 08-0750 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

HARNESS, DICKEY & PIERCE, P.L.C

By: _____
Donald J. Daley, Reg. No. 34,313

DJD:kna

P.O. Box 8910
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New Application
Docket No.: 32860-000284/US

ABSTRACT OF THE DISCLOSURE

An electromagnetic switching device is monitored at least for the correct connection of an input contact and of an output contact by a contact bridge. For this purpose, a monitoring circuit is coupled to the contacts before the contact bridge is moved into a connection position when a connection command is given, and an indicator of the correct connection of the contacts is determined by evaluation of a contact voltage dropped across the contacts and supplied to the monitoring circuit.

Sub Spec

New Application
Docket No. 32860-000284/US

CONTROL SYSTEM FOR AN ELECTROMAGNETIC SWITCHING DEVICE AND ELECTROMAGNETIC SWITCHING DEVICE CORRESPONDING THERETO

[0001] This application is the national phase under 35 U.S.C. § 371 of PCT International Application No. PCT/DE00/02522 which has an International filing date of July 31, 2000, which designated the United States of America, the entire contents of which are hereby incorporated by reference.

Field of the Invention

[0002] The present invention generally relates to a method and system for monitoring an electromagnetic switching device, and to an electromagnetic switching device itself. More particularly, it can include a method at least for the correct connection of an input contact and of an output contact using a contact bridge. The contact bridge can be moved from a separated position into a connection position using a bridge drive when a connection command is given, if the contacts are correctly connected. The electromagnetic switching device can include circuit breakers, relays, etc..

Background of the Invention

[0003] Electromagnetic switching devices, including circuit breakers and relays, are generally known. They exhibit at least one input contact and one output contact which are connected to one another or separated from one another via a contact bridge. Apart from normal wear, two types of disturbances can essentially occur. One disturbance is the breaking of the contact bridge. In this case, the contacts can no longer be correctly connected to one another. The other disturbance is that the contact bridge becomes welded to the contacts. In this case, the contacts can no longer be correctly separated from one another. A broken bridge, in particular, can lead to the destruction of the entire electromagnetic switching device and also to disturbances in a connected installation.

[0004] Naturally, it is possible to check the electromagnetic switching device for correct functioning in a test circuit. However, this test is done in a test circuit. Continuous monitoring of the electromagnetic switching device during its operation is not possible by this means.

SUMMARY OF THE INVENTION

[0005] An object of an embodiment of the present invention includes creating a monitoring method for an electromagnetic switching device (including circuit breakers, relays, etc.) and an electromagnetic switching device corresponding thereto, via which the electromagnetic switching device can be monitored at least for a correct connection of the contacts in continuous operation.

[0006] An object can be achieved for the monitoring method in that when the connection command is given, a monitoring circuit is coupled to the contacts before the contact bridge is moved into the connection position. An indicator of the correct connection of the contacts can be determined by evaluating a contact voltage which is dropped across the contacts and which is supplied to the monitoring circuit.

[0007] Correspondingly, an object with respect to the electromagnetic switching device can be achieved in that

- a monitoring circuit can be coupled to the contacts via an auxiliary switch,
- the auxiliary switch can be constructed in such a manner that when a connection command is given, the auxiliary switch is closed before the contact bridge is moved into the connection position, and
- the monitoring circuit can deliver an indicator of the correct connection of the contacts.

[0008] If the contact bridge is moved from the connection position into the separated position using the bridge drive when a separating command is given when the contacts are correctly separated, the monitoring circuit is decoupled from at least one of the contacts after the contact bridge has been moved into the separated position when a separating command is given. An indicator of the correct separation of the contacts can then be determined by evaluation of the contact voltage. The electromagnetic switching device can also be monitored for correct separation of the input contact from the output contact by the contact bridge.

[0009] If the contact voltage is rectified before it is supplied to the monitoring circuit, the monitoring circuit can be used independently of the type and possibly polarization of the switched voltage.

[0010] If a preliminary signal corresponding to the contact voltage is supplied to an evaluating unit which determines the indicator, the determination of the indicator can be particularly simple.

[0011] If the preliminary signal is supplied to the evaluating unit in a DC-isolated manner, the evaluating unit can be incorporated in a particularly simple manner into a higher-level controller and/or the circuit breaker controller. In particular, it is possible to move the electromagnetic switching device into a safe state if the contacts are incorrectly connected or separated, respectively. As an alternative or additionally, it is possible to signal the incorrect connection or separation of the contacts to a higher-level controller if the contacts are not correctly connected or separated, respectively.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Further advantages and details can be obtained from the subsequent description of an exemplary embodiment. In a basic representation,

Figure 1 shows an electromagnetic switching device with a monitoring circuit and

Figures 2-4 in each case show a switching diagram of the electromagnetic switching device and a variation of the preliminary signal.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] According to an embodiment of Figure 1, an electromagnetic switching device 1 is constructed as circuit breaker. It exhibits at least one input contact 2 and an output contact 3 corresponding thereto and a contact bridge 4. If the electromagnetic switching device 1 is operating correctly, the contact bridge 4 is moved from a separated position into a connection position when a connection command is given. When a separating command is given, the contact bridge 4 is moved from the connection position into the separated position. In the connection position of the contact bridge 4, the contacts 2, 3 are connected to one another. In the separated position, they are separated from one another. The contact bridge 4 is moved from the separated position into the connection position and conversely using a bridge drive 5.

[0014] To monitor the electromagnetic switching device 1 for correct connection and separation of the contacts 2, 3 the electromagnetic switching device 1 exhibits a monitoring circuit 6. The monitoring circuit 6 is preceded by a rectifier 7. The rectifier 7, in turn, is preceded by an auxiliary switch 8. The monitoring circuit 6 can be coupled to the contacts 2, 3 and decoupled from the input contact 2 via the auxiliary switch 8. When the auxiliary switch 8 is closed, the monitoring circuit 6 is supplied with a contact voltage U which is dropped across the contacts 2, 3. Due to the presence of the rectifier 7, the contact voltage U is supplied rectified to the monitoring circuit 6.

[0015] The auxiliary switch 8 is constructed in such a manner that it leads when the contact bridge 4 is moved into the connection position and lags when the contact bridge 4 is moved into the separated position. When a connection command is given, the auxiliary switch 8 is thus closed before the contact bridge 4 is moved into the connection position. When a separating command is given, on the other hand, the auxiliary switch 8 is only opened after the contact bridge 4 has been moved into the separated position. When the connection command is given, the monitoring circuit 6 is thus coupled to the contacts 2, 3 before the contact bridge 4 is moved into the connection position. When a separating command is given, it is only decoupled from the input contact 2 after the contact bridge 4 has been moved into

the separated position. This makes it possible for the monitoring circuit 6, by evaluating the contact voltage U supplied to it, to determine an indicator of the correct connection and separation, respectively, of the contacts 2, 3. The indicator can then be output by the monitoring circuit 6.

[0016] Due to the rectification of the contact voltage U, the construction of the monitoring circuit 6 can be independent of the polarization of the voltage to be switched and can also be independent of whether the voltage to be switched is a direct voltage or an alternating voltage.

[0017] According to an embodiment of Figure 1, the monitoring circuit 6 can include a contact voltage indicator 9 and an evaluating unit 10. The contact voltage indicator 9 is constructed as a constant current source according to an embodiment of Figure 1. When a contact voltage U is present, the contact voltage indicator 9 thus outputs a constant current I independently of the magnitude of the voltage. The constant current I thus represents a preliminary signal corresponding to the contact voltage U.

[0018] The preliminary signal is supplied to the evaluating unit 10 DC-isolated via an optocoupler 12. The evaluating unit 10 then determines the indicator for the separation or connection, respectively, of the contacts 2, 3.

[0019] It is possible that the evaluating unit 10 only indicates the presence or absence of correct operation of the switching device 1 via an indicator, e.g. a light-emitting diode. In this case, manual intervention by an operating person must take place if the switching device 1 is not correctly operating. However, the evaluating unit 10 is preferably connected to the bridge drive 5 by control technology. In this case, it is possible for the electromagnetic switching device 1 to be moved into a safe state if the contacts 2, 3 are not correctly connected or separated.

[0020] As an alternative or additionally, the evaluating unit 10 can also be communicatively connected to a higher-level controller 12.

[0021] In this case, a corresponding message can be conveyed to the higher-level controller 12 if the contacts 2, 3 are not correctly connected or separated.

[0022] Figures 2 to 4 show embodiments illustrating how the preliminary signal conveyed from the optocoupler 11 to the evaluating unit 10, can be evaluated.

[0023] According to the embodiments of Figures 2 to 4, a connection command is given to the electromagnetic switching device 1 at a time t1 and a separating command is given at a time t2. As the connection command is given, the auxiliary switch 8 is closed at the same time or directly thereafter. The contacts 2, 3, on the other hand, are only closed later, namely at a time t3, if they are operating correctly according to the embodiments of Figures 2 and 3. According to Figures 2 and 3, a preliminary signal is output via the optocoupler 11 between

times t1 and t3 and is no longer given thereafter. If, on the other hand, as shown in the embodiment of Figure 4, the contact bridge 4 is broken or the contacts 2, 3 are not connected to one another for other reasons, the optocoupler 11 transmits a continuous signal from time t1 onward. The occurrence of a continuous signal can thus be used as indicator of a broken contact bridge 4.

[0024] After the separating command has been given, the contacts 2, 3 are immediately separated from one another again but the auxiliary switch 8 is only separated at a time t4. When the switching device 1 is operating correctly according to the embodiment of Figure 2, a preliminary signal is again conveyed to the evaluating unit 10 between times t3 and t4.

[0025] If, on the other hand, as shown in the embodiment of Figure 3, the contact bridge 4 is welded to the contacts 2, 3, the second pulse is missing. The lack of the second pulse can be used as indicator of nonseparation of the contacts 2, 3. Naturally, after the auxiliary switch 8 has opened, the preliminary signal also goes back down to zero if the contacts 2, 3 are separated from one another.

[0026] The switching device 1 described above and the monitoring method corresponding thereto can be used not only with single phase direct-voltage and alternating-voltage systems but also with multi-phase three-phase systems. In this case, a separate auxiliary switch 8 and a separate contact voltage indicator 9 are required for each pair of an input and output contact 2, 3 which can be connected to one another via a contact bridge 4. The evaluating unit 10 can be optionally separate or common to all phases.

[0027] In the case of a star connection with separate neutral conductor, unrestricted monitoring of the switched contacts 2, 3 is possible. In the case of a delta connection, unrestricted monitoring of the switched contacts 2, 3 for correct connection is possible. Nonseparation of one of three contacts cannot be detected, nonseparation of two or three contact pairs, on the other hand, can also be detected in the case of a delta connection.

[0028] The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

Marked-up Spec

GR 99 P 3649

~~Description~~

Control System

Monitoring ~~method~~ for An Electromagnetic Switching Device And Electromagnetic Switching Device Corresponding Thereto

PCT ft (PCT/DE00/02522) 7/31/00

FIELD OF THE INVENTION

The present invention relates to a method and system generally and to an electromagnetic switching device itself. More particularly, it can include a method for monitoring an electromagnetic switching device at least for the correct connection of an input contact and of an output contact ~~by means of~~ using a contact bridge. The contact bridge can be ~~being~~ moved from a separated position into a connection position ~~by means of~~ using a bridge drive when a connection command is given, if the contacts are correctly connected. The electromagnetic switching device can include circuit breakers, relays, etc. ~~and to an electromagnetic switching device corresponding thereto~~.

BACKGROUND OF THE INVENTION

Electromagnetic switching devices, ~~that is to say~~ including circuit breakers and relays, are generally known. They exhibit at least one input contact and one output contact which are connected to one another or separated from one another ~~by means of~~ via a contact bridge. Apart from normal wear, two types of disturbances can essentially occur. One disturbance is the breaking of the contact bridge. In this case, the contacts can no longer be correctly connected to one another. The other disturbance is that the contact bridge becomes welded to the contacts. In this case, the contacts can no longer be correctly separated from one another. A broken bridge, in particular, can lead to the destruction of the entire electromagnetic switching device and also to disturbances in a connected installation.

Naturally, it is possible to check the electromagnetic switching device for correct functioning in a test circuit. However, this test is done in a test circuit. Continuous monitoring of the electromagnetic switching device during its operation is not possible by this means.

SUMMARY OF THE INVENTION

An ~~The~~ object of ~~an embodiment of~~ the present invention ~~consists in~~ includes creating a monitoring method for an electromagnetic switching device (including circuit breakers, relays, etc.) and an electromagnetic switching device corresponding thereto, ~~by means of~~ via which the electromagnetic switching device can be monitored at least for a correct connection of the contacts in continuous operation.

An ~~The~~ object ~~is~~ can be achieved for the monitoring method in that when the connection command is given, a monitoring circuit is coupled to the contacts before the contact bridge is moved into the connection position, ~~and~~ an indicator of the correct connection of the contacts ~~is~~ can be determined by evaluating a contact voltage which is dropped across the contacts and which is supplied to the monitoring circuit.

Correspondingly, ~~the~~ an object with respect to the electromagnetic switching device ~~is~~ can be achieved in that

- a monitoring circuit can be coupled to the contacts via an auxiliary switch,
- ~~that~~ the auxiliary switch ~~is~~ can be constructed in such a manner that when a connection command is given, the auxiliary switch is closed before the contact bridge is moved into the connection position, and
- ~~that~~ the monitoring circuit ~~delivers~~ can deliver an indicator of the correct connection of the contacts.

If the contact bridge is moved from the connection position into the separated position ~~by means of~~ using the bridge drive when a separating command is given when the contacts are correctly separated, the monitoring circuit is decoupled from at least one of the contacts after the contact bridge has been moved into the separated position when a separating command is given, ~~and~~ an indicator of the correct separation of the contacts ~~is~~ can then be determined by evaluation of the contact voltage. The electromagnetic switching device can also be monitored for correct separation of the input contact from the output contact by the contact bridge.

If the contact voltage is rectified before it is supplied to the monitoring circuit, the monitoring circuit can be used independently of the type and possibly polarization of the switched voltage.

If a preliminary signal corresponding to the contact voltage is supplied to an evaluating unit which determines the indicator, the determination of the indicator can be particularly simple.

If the preliminary signal is supplied to the evaluating unit in a DC-isolated manner, the evaluating unit can be incorporated in a particularly simple manner into a higher-level controller and/or the circuit breaker controller. In particular, it is possible to move the electromagnetic switching device into a safe state if the contacts are incorrectly connected or separated, respectively. As an alternative or additionally, it is possible to signal the incorrect connection or separation of the contacts to a higher-level controller if the contacts are not correctly connected or separated, respectively.

BRIEF DESCRIPTION OF THE DRAWINGS

Further advantages and details can be obtained from the subsequent description of an exemplary embodiment. In a basic representation,

Figure 1 shows an electromagnetic switching device with a monitoring circuit and

Figures 2-4 in each case show a switching diagram of the electromagnetic switching device and a variation of the preliminary signal.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

According to an embodiment of Figure 1, an electromagnetic switching device 1 is constructed as circuit breaker. It exhibits at least one input contact 2 and an output contact 3 corresponding thereto, and a contact bridge 4. If the electromagnetic switching device 1 is operating

correctly, the contact bridge 4 is moved from a separated position into a connection position when a connection command is given. When a separating command is given, the contact bridge 4 is moved from the

connection position into the separated position. In the connection position of the contact bridge 4, the contacts 2, 3 are connected to one another. In the separated position, they are separated from one another. The contact bridge 4 is moved from the separated position into the connection position and conversely ~~by means of~~ using a bridge drive 5.

To monitor the electromagnetic switching device 1 for correct connection and separation of the contacts 2, 3 the electromagnetic switching device 1 exhibits a monitoring circuit 6. The monitoring circuit 6 is preceded by a rectifier 7. The rectifier 7, in turn, is preceded by an auxiliary switch 8. The monitoring circuit 6 can be coupled to the contacts 2, 3 and decoupled from the input contact 2 ~~by means of~~ via the auxiliary switch 8. When the auxiliary switch 8 is closed, the monitoring circuit 6 is supplied with a contact voltage U which is dropped across the contacts 2, 3. Due to the presence of the rectifier 7, the contact voltage U is supplied rectified to the monitoring circuit 6.

The auxiliary switch 8 is constructed in such a manner that it leads when the contact bridge 4 is moved into the connection position and lags when the contact bridge 4 is moved into the separated position. When a connection command is given, the auxiliary switch 8 is thus closed before the contact bridge 4 is moved into the connection position. When a separating command is given, on the other hand, the auxiliary switch 8 is only opened after the contact bridge 4 has been moved into the separated position. When the connection command is given, the monitoring circuit 6 is thus coupled to the contacts 2, 3 before the contact bridge 4 is moved into the connection position. When a separating command is given, it is only decoupled from the input contact 2 after the contact bridge 4 has been moved into the separated position. This makes it

possible for the monitoring circuit 6, by evaluating the contact voltage U supplied to it, to determine an indicator of the correct

connection and separation, respectively, of the contacts 2, 3. The indicator can then be output by the monitoring circuit 6.

Due to the rectification of the contact voltage U, the construction of the monitoring circuit 6 can be independent of the polarization of the voltage to be switched and can also be independent of whether the voltage to be switched is a direct voltage or an alternating voltage.

According to the embodiment of Figure 1, the monitoring circuit 6 can include ~~exhibits~~ a contact voltage indicator 9 and an evaluating unit 10. The contact voltage indicator 9 is constructed as a constant current source according to the embodiment of Figure 1. When a contact voltage U is present, the contact voltage indicator 9 thus outputs a constant current I independently of the magnitude of the voltage. The constant current I thus represents a preliminary signal corresponding to the contact voltage U.

The preliminary signal is supplied to the evaluating unit 10 DC-isolated via an optocoupler 12. The evaluating unit 10 then determines the indicator for the separation or connection, respectively, of the contacts 2, 3.

It is possible that the evaluating unit 10 only indicates the presence or absence of correct operation of the switching device 1 via an indicator, e.g. a light-emitting diode. In this case, manual intervention by an operating person must take place if the switching device 1 is not correctly operating. However, the evaluating unit 10 is preferably connected to the bridge drive 5 by control technology. In this case, it is possible for the electromagnetic switching device 1 to be moved into a safe state if the contacts 2, 3 are not correctly connected or separated.

As an alternative or additionally, the evaluating unit 10 can also be communicatively connected to a higher-level controller 12.

In this case, a corresponding message can be conveyed to the higher-level controller 12 if the contacts 2, 3 are not correctly connected or separated.

Figures 2 to 4 show embodiments illustrating how the preliminary signal conveyed from the optocoupler 11 to the evaluating unit 10 can be evaluated.

According to the embodiments of Figures 2 to 4, a connection command is given to the electromagnetic switching device 1 at a time t1 and a separating command is given at a time t2. As the connection command is given, the auxiliary switch 8 is closed at the same time or directly thereafter. The contacts 2, 3, on the other hand, are only closed later, namely at a time t3, if they are operating correctly according to the embodiments of Figures 2 and 3. According to Figures 2 and 3, a preliminary signal is output via the optocoupler 11 between times t1 and t3 and is no longer given thereafter. If, on the other hand, as shown in the embodiment of Figure 4, the contact bridge 4 is broken or the contacts 2, 3 are not connected to one another for other reasons, the optocoupler 11 transmits a continuous signal from time t1 onward. The occurrence of a continuous signal can thus be used as indicator of a broken contact bridge 4.

After the separating command has been given, the contacts 2, 3 are immediately separated from one another again but the auxiliary switch 8 is only separated at a time t4. When the switching device 1 is operating correctly according to the embodiment of Figure 2, a preliminary signal is again conveyed to the evaluating unit 10 between times t3 and t4.

If, on the other hand, as shown in the embodiment of Figure 3, the contact bridge 4 is welded to the contacts 2, 3, the second pulse is missing. The lack of the second pulse can be used as indicator of nonseparation of the contacts 2, 3.

Naturally, after the auxiliary switch 8 has opened, the preliminary signal also goes back down to zero if the contacts 2, 3 are separated from one another.

The switching device 1 described above and the monitoring method corresponding thereto can be used not only with single phase direct-voltage and alternating-voltage systems but also with multi-phase three-phase systems. In this case, a separate auxiliary switch 8 and a separate contact voltage indicator 9 are required for each pair of an input and output contact 2, 3 which can be connected to one another via a contact bridge 4. The evaluating unit 10 can be optionally separate or common to all phases.

In the case of a star connection with separate neutral conductor, unrestricted monitoring of the switched contacts 2, 3 is possible. In the case of a delta connection, unrestricted monitoring of the switched contacts 2, 3 for correct connection is possible. Nonseparation of one of three contacts cannot be detected, nonseparation of two or three contact pairs, on the other hand, can also be detected in the case of a delta connection.

VARIATIONS

MARKED-UP CLAIMS 10038166.031502

What is claimed is:

~~Patent claims~~

(Amended)

1. A method for monitoring an electromagnetic switching device (1) at least for the correct connection of an input contact (2) and of an output contact (3) by means of a contact bridge (4), the contact bridge (4) being moved from a separated position into a connection position by means of a bridge drive (5) when a connection command is given, if the contacts (2, 3) are correctly connected, comprising:

characterized in that

when the connection command is given, a monitoring circuit (6) is coupled to the contacts (2, 3) before the contact bridge (4) is moved into the connection position, and

that an indicator of the correct connection of the contacts (2, 3) is determined by evaluation of a contact voltage (U) dropped across the contacts (2, 3) and supplied to the monitoring circuit (6).

(Amended)

2. The monitoring method as claimed in claim 1,

characterized in that wherein

the electromagnetic switching device (1) is also monitored for correct separation of the input contact (2) from the output contact (3) by the contact bridge (4), further comprising:

that if the contacts (2, 3) are correctly separated, the contact bridge (4) is moved from the connection position into the separated position by means of the bridge drive (5), when a separating command is given;

that when a separating command is given, the monitoring circuit (6) is decoupled from at least one of the contacts (2, 3) after the contact bridge (4) has moved into the separated position; and

that an indicator of the correct separation of the contacts (2, 3) is determined by evaluation of the contact voltage (U).

(Amended) 3. The monitoring method as claimed in claim 1 [or 2], Further comprising: rectifying characterized in that the contact voltage ((U) is rectified] before it is supplied to the monitoring circuit [(6)].

(Amended) 4. The monitoring method as claimed in claim 1 [2 or 3], [characterized in that] wherein a preliminary signal, (I) corresponding to the contact voltage ((U)), is supplied to an evaluating unit [(10)] [which determines] to aid in determining the indicator.

(Amended) 5. The monitoring method as claimed in claim 4, [characterized in that] wherein the preliminary signal ((I)) is supplied DC-isolated to the evaluating unit [(10)].

(Amended) 6. The monitoring method as claimed in [one of claims] claim 1 [to 5], [characterized in that] wherein the electromagnetic switching device [(1)] is moved into a safe state if the contacts [(2, 3)] are not correctly connected or separated, respectively.

(Amended) 7. The monitoring method as claimed in [one of claims] claim 6 [to 6], [characterized in that] wherein the incorrect connection or separation of the contacts [(2, 3)] is signaled to a higher-level controller [(12)] if the contacts [(2, 3)] are not correctly connected or separated, respectively.

(Amended) 8. An electromagnetic switching device, comprising: at least one input contact [(2)] [and] one output contact [(3)] [and] a contact bridge [(4)], [wherein] the contact bridge [(4)] can be moved [from a separated position into] to a connection position [by means of a bridge drive (5)] when a connection command is given, [characterized in that] wherein

a monitoring circuit (6) can be coupled to the contacts (2, 3) via an auxiliary switch (8), wherein that the auxiliary switch (8) is constructed in such a manner that, when a connection command is given, the auxiliary switch (8) is closed before the contact bridge (4) is moved into the connection position, and wherein that the monitoring circuit (6) outputs an indicator of the correct connection of the contacts (2, 3).

(Amended)

9. The switching device as claimed in claim 8, characterized in that wherein the monitoring circuit (6) can be decoupled from at least one of the contacts (2, 3) via the auxiliary switch (8), wherein that the auxiliary switch (8) is constructed in such a manner that when a separating command is given, the auxiliary switch (8) is opened after the contact bridge (4) has been moved into the separated position, and that wherein the monitoring circuit (6) outputs an indicator of the correct separation of the contacts (2, 3).

(Amended)

10. The switching device as claimed in claim 8 or 9, characterized in that wherein the monitoring circuit (6) is preceded by a rectifier (7).

(Amended)

11. The switching device as claimed in claim 8, 9 or 10, characterized in that wherein the monitoring circuit (6) includes exhibits a contact voltage indicator (9) and an evaluating unit (10), that wherein the contact voltage indicator (9) outputs to the evaluating unit (10) a preliminary signal (I) corresponding to the contact voltage (U) and that wherein the evaluating unit (10) uses the preliminary signal to aid in determining determines the indicator.

(Amended) 12. The switching device as claimed in claim 11, characterized in that wherein the contact voltage indicator (9) is DC-isolated from the evaluating unit (10).

(Amended) 13. The switching device as claimed in one of claims claim 9, to 12, characterized in that wherein the monitoring circuit (6) is connected to the bridge drive (5) by control technology.

(Amended) 14. The switching device as claimed in one of claims claim 8 to 13, characterized in that wherein the monitoring circuit (6) is communicatively connected to a higher-level controller (12).

NEW

15. Same as 3, but dep on 2
16. Same as 4, but dep on 2
17. Same as 5, but dep on 16
18. Same as 6, but dep on 2
19. Same as 7, but dep on 18
20. Same as 10, but dep on 9
21. Same as 11, but dep on 9
22. Same as 12, but dep on 21
23. Same as 13, but dep on 8
24. Same as 14, but dep on 9
25. The method of claim 1, wherein the electromagnetic switching device is a circuit breaker.
26. Same as 25, but dep on 2 -- device -- instead of "method"
27. Same as 25, but dep on 8
28. Same as 27, but dep on 9
29. A monitoring circuit, coupleable to input and output contacts of an electromagnetic switching device, comprising:
a contact voltage indicator; and
an evaluating unit, wherein the monitoring circuit is coupleable to the contacts when a connection of the electromagnetic switching device is formed before a contact bridge moved from a separated position to a connection position, wherein the contact voltage indicator outputs a preliminary signal to the evaluation unit corresponding to a contact voltage, wherein the evaluation unit uses the preliminary signal to aid in determining an indicator of correct connection of the contacts, such that the contact bridge is moved from a separated position to upon determining that

30. Same as 29, but dep on 2

31. The monitoring circuit of claim 29, wherein the monitoring circuit is coupleable to the contacts via an auxiliary switch.

32. The monitoring circuit of claim 31, wherein the monitoring circuit is coupleable to the contacts via an auxiliary switch.

33. Same as 9, except "monitoring circuit" instead of switching device + dep on 32.

34. Same as 10, except "monitoring circuit" + dep on 33

35. Same as 12, but "monitoring cir." + dep on 31

36. The monitoring circuit of claim 31, wherein a bridge drive moves the contact bridge and wherein [cl. 13].

37. Same as 36, but insert [cl. 14]

MARKED-UP ABSTRACT

Abstract

Monitoring method for an electromagnetic switching device and electromagnetic switching device corresponding thereto

An electromagnetic switching device (1) is to be monitored at least for the correct connection of an input contact (2) and of an output contact (3) by a contact bridge (4). For this purpose, a monitoring circuit (6) is coupled to the contacts (2, 3) before the contact bridge (4) is moved into a connection position, when a connection command is given, and an indicator of the correct connection of the contacts (2, 3) is determined by evaluation of a contact voltage (U) dropped across the contacts (2, 3) and supplied to the monitoring circuit (6).

Figure 1

GR 99 P 3649

Description

2/prts

Monitoring method for an electromagnetic switching device and electromagnetic switching device corresponding thereto

The present invention relates to a method for monitoring an electromagnetic switching device at least for the correct connection of an input contact and of an output contact by means of a contact bridge, the contact bridge being moved from a separated position into a connection position by means of a bridge drive when a connection command is given, if the contacts are correctly connected, and to an electromagnetic switching device corresponding thereto.

Electromagnetic switching devices, that is to say circuit breakers and relays, are generally known. They exhibit at least one input contact and one output contact which are connected to one another or separated from one another by means of a contact bridge. Apart from normal wear, two types of disturbances can essentially occur. One disturbance is the breaking of the contact bridge. In this case, the contacts can no longer be correctly connected to one another. The other disturbance is that the contact bridge becomes welded to the contacts. In this case, the contacts can no longer be correctly separated from one another. A broken bridge, in particular, can lead to the destruction of the entire electromagnetic switching device and also to disturbances in a connected installation.

Naturally, it is possible to check the electromagnetic switching device for correct functioning in a test circuit. However, this test is done in a test circuit. Continuous monitoring of the electromagnetic switching device during its operation is not possible by this means.

The object of the present invention consists in creating a monitoring method for an electromagnetic switching device and an electromagnetic switching device corresponding thereto, by means of which the electromagnetic switching device can be monitored at least for a correct connection of the contacts in continuous operation.

The object is achieved for the monitoring method in that when the connection command is given, a monitoring circuit is coupled to the contacts before the contact bridge is moved into the connection position and an indicator of the correct connection of the contacts is determined by evaluating a contact voltage which is dropped across the contacts and which is supplied to the monitoring circuit.

Correspondingly, the object with respect to the electromagnetic switching device is achieved in that

- a monitoring circuit can be coupled to the contacts via an auxiliary switch,
- that the auxiliary switch is constructed in such a manner that when a connection command is given, the auxiliary switch is closed before the contact bridge is moved into the connection position, and
- that the monitoring circuit delivers an indicator of the correct connection of the contacts.

If the contact bridge is moved from the connection position into the separated position by means of the bridge drive when a separating command is given when the contacts are correctly separated, the monitoring circuit is decoupled from at least one of the contacts after the contact bridge has been moved into the separated position when a separating command is given, and an indicator of the correct separation of the contacts is determined by evaluation of the contact voltage, the electromagnetic switching device can also be monitored for correct separation of the input contact from the output contact by the contact bridge.

If the contact voltage is rectified before it is supplied to the monitoring circuit, the monitoring circuit can be used independently of the type and possibly polarization of the switched voltage.

If a preliminary signal corresponding to the contact voltage is supplied to an evaluating unit which determines the indicator, the determination of the indicator is particularly simple.

If the preliminary signal is supplied to the evaluating unit in a DC-isolated manner, the evaluating unit can be incorporated in a particularly simple manner into a higher-level controller and/or the circuit breaker controller. In particular, it is possible to move the electromagnetic switching device into a safe state if the contacts are incorrectly connected or separated, respectively. As an alternative or additionally, it is possible to signal the incorrect connection or separation of the contacts to a higher-level controller if the contacts are not correctly connected or separated, respectively.

Further advantages and details can be obtained from the subsequent description of an exemplary embodiment. In a basic representation,

Figure 1 shows an electromagnetic switching device with a monitoring circuit and

Figures 2-4 in each case show a switching diagram of the electromagnetic switching device and a variation of the preliminary signal.

According to Figure 1, an electromagnetic switching device 1 is constructed as circuit breaker. It exhibits at least one input contact 2 and an output contact 3 corresponding thereto and a contact bridge 4. If the electromagnetic switching device 1 is operating

correctly, the contact bridge 4 is moved from a separated position into a connection position when a connection command is given. When a separating command is given, the contact bridge 4 is moved from the

connection position into the separated position. In the connection position of the contact bridge 4, the contacts 2, 3 are connected to one another. In the separated position, they are separated from one another. The contact bridge 4 is moved from the separated position into the connection position and conversely by means of a bridge drive 5.

To monitor the electromagnetic switching device 1 for correct connection and separation of the contacts 2, 3 the electromagnetic switching device 1 exhibits a monitoring circuit 6. The monitoring circuit 6 is preceded by a rectifier 7. The rectifier 7, in turn, is preceded by an auxiliary switch 8. The monitoring circuit 6 can be coupled to the contacts 2, 3 and decoupled from the input contact 2 by means of the auxiliary switch 8. When the auxiliary switch 8 is closed, the monitoring circuit 6 is supplied with a contact voltage U which is dropped across the contacts 2, 3. Due to the presence of the rectifier 7, the contact voltage U is supplied rectified to the monitoring circuit 6.

The auxiliary switch 8 is constructed in such a manner that it leads when the contact bridge 4 is moved into the connection position and lags when the contact bridge 4 is moved into the separated position. When a connection command is given, the auxiliary switch 8 is thus closed before the contact bridge 4 is moved into the connection position. When a separating command is given, on the other hand, the auxiliary switch 8 is only opened after the contact bridge 4 has been moved into the separated position. When the connection command is given, the monitoring circuit 6 is thus coupled to the contacts 2, 3 before the contact bridge 4 is moved into the connection position. When a separating command is given, it is only decoupled from the input contact 2 after the contact bridge 4 has been moved into the separated position. This makes it

possible for the monitoring circuit 6, by evaluating the contact voltage U supplied to it, to determine an indicator of the correct

connection and separation, respectively, of the contacts 2, 3. The indicator can then be output by the monitoring circuit 6.

Due to the rectification of the contact voltage U, the construction of the monitoring circuit 6 can be independent of the polarization of the voltage to be switched and can also be independent of whether the voltage to be switched is a direct voltage or an alternating voltage.

According to Figure 1, the monitoring circuit 6 exhibits a contact voltage indicator 9 and an evaluating unit 10. The contact voltage indicator 9 is constructed as a constant current source according to Figure 1. When a contact voltage U is present, the contact voltage indicator 9 thus outputs a constant current I independently of the magnitude of the voltage. The constant current I thus represents a preliminary signal corresponding to the contact voltage U.

The preliminary signal is supplied to the evaluating unit 10 DC-isolated via an optocoupler 12. The evaluating unit 10 then determines the indicator for the separation or connection, respectively, of the contacts 2, 3.

It is possible that the evaluating unit 10 only indicates the presence or absence of correct operation of the switching device 1 via an indicator, e.g. a light-emitting diode. In this case, manual intervention by an operating person must take place if the switching device 1 is not correctly operating. However, the evaluating unit 10 is preferably connected to the bridge drive 5 by control technology. In this case, it is possible for the electromagnetic switching device 1 to be moved into a safe state if the contacts 2, 3 are not correctly connected or separated.

As an alternative or additionally, the evaluating unit 10 can also be communicatively connected to a higher-level controller 12.

In this case, a corresponding message can be conveyed to the higher-level controller 12 if the contacts 2, 3 are not correctly connected or separated.

Figures 2 to 4 show how the preliminary signal conveyed from the optocoupler 11 to the evaluating unit 10 can be evaluated.

According to Figures 2 to 4, a connection command is given to the electromagnetic switching device 1 at a time t1 and a separating command is given at a time t2. As the connection command is given, the auxiliary switch 8 is closed at the same time or directly thereafter. The contacts 2, 3, on the other hand, are only closed later, namely at a time t3, if they are operating correctly according to Figures 2 and 3. According to Figures 2 and 3, a preliminary signal is output via the optocoupler 11 between times t1 and t3 and is no longer given thereafter. If, on the other hand, as shown in Figure 4, the contact bridge 4 is broken or the contacts 2, 3 are not connected to one another for other reasons, the optocoupler 11 transmits a continuous signal from time t1 onward. The occurrence of a continuous signal can thus be used as indicator of a broken contact bridge 4.

After the separating command has been given, the contacts 2, 3 are immediately separated from one another again but the auxiliary switch 8 is only separated at a time t4. When the switching device 1 is operating correctly according to Figure 2, a preliminary signal is again conveyed to the evaluating unit 10 between times t3 and t4.

If, on the other hand, as shown in Figure 3, the contact bridge 4 is welded to the contacts 2, 3, the second pulse is missing. The lack of the second pulse can be used as indicator of nonseparation of the contacts 2, 3.

Naturally, after the auxiliary switch 8 has opened, the preliminary signal also goes back down to zero if the contacts 2, 3 are separated from one another.

The switching device 1 described above and the monitoring method corresponding thereto can be used not only with single phase direct-voltage and alternating-voltage systems but also with multi-phase three-phase systems. In this case, a separate auxiliary switch 8 and a separate contact voltage indicator 9 are required for each pair of an input and output contact 2, 3 which can be connected to one another via a contact bridge 4. The evaluating unit 10 can be optionally separate or common to all phases.

In the case of a star connection with separate neutral conductor, unrestricted monitoring of the switched contacts 2, 3 is possible. In the case of a delta connection, unrestricted monitoring of the switched contacts 2, 3 for correct connection is possible. Nonseparation of one of three contacts cannot be detected, nonseparation of two or three contact pairs, on the other hand, can also be detected in the case of a delta connection.

Patent claims

1. A method for monitoring an electromagnetic switching device (1) at least for the correct connection of an input contact (2) and of an output contact (3) by means of a contact bridge (4), the contact bridge (4) being moved from a separated position into a connection position by means of a bridge drive (5) when a connection command is given, if the contacts (2, 3) are correctly connected,
characterized in that
- when the connection command is given, a monitoring circuit (6) is coupled to the contacts (2, 3) before the contact bridge (4) is moved into the connection position, and
- that an indicator of the correct connection of the contacts (2, 3) is determined by evaluation of a contact voltage (U) dropped across the contacts (2, 3) and supplied to the monitoring circuit (6).

2. The monitoring method as claimed in claim 1,
characterized in that
- the electromagnetic switching device (1) is also monitored for correct separation of the input contact (2) from the output contact (3) by the contact bridge (4),
- that if the contacts (2, 3) are correctly separated, the contact bridge (4) is moved from the connection position into the separated position by means of the bridge drive (5) when a separating command is given,
- that when a separating command is given, the monitoring circuit (6) is decoupled from at least one of the contacts (2, 3) after the contact bridge (4) has moved into the separated position, and
- that an indicator of the correct separation of the contacts (2, 3) is determined by evaluation of the contact voltage (U).

3. The monitoring method as claimed in claim 1 or 2, characterized in that the contact voltage (U) is rectified before it is supplied to the monitoring circuit (6).

4. The monitoring method as claimed in claim 1, 2 or 3, characterized in that a preliminary signal (I) corresponding to the contact voltage (U) is supplied to an evaluating unit (10) which determines the indicator.

5. The monitoring method as claimed in claim 4, characterized in that the preliminary signal (I) is supplied DC-isolated to the evaluating unit (10).

6. The monitoring method as claimed in one of claims 1 to 5, characterized in that the electromagnetic switching device (1) is moved into a safe state if the contacts (2, 3) are not correctly connected or separated, respectively.

7. The monitoring method as claimed in one of claims 1 to 6, characterized in that the incorrect connection or separation of the contacts (2, 3) is signaled to a higher-level controller (12) if the contacts (2, 3) are not correctly connected or separated, respectively.

8. An electromagnetic switching device comprising at least one input contact (2) and one output contact (3) and a contact bridge (4), wherein the contact bridge (4) can be moved from a separated position into a connection position by means of a bridge drive (5) when a connection command is given, characterized in that

- a monitoring circuit (6) can be coupled to the contacts (2, 3) via an auxiliary switch (8),
- that the auxiliary switch (8) is constructed in such a manner that, when a connection command is given, the auxiliary switch (8) is closed before the contact bridge (4) is moved into the connection position, and
- that the monitoring circuit (6) outputs an indicator of the correct connection of the contacts (2, 3).

9. The switching device as claimed in claim 8, characterized in that
   - the monitoring circuit (6) can be decoupled from at least one of the contacts (2, 3) via the auxiliary switch (8),
   - that the auxiliary switch (8) is constructed in such a manner that when a separating command is given, the auxiliary switch (8) is opened after the contact bridge (4) has been moved into the separated position, and
   - that the monitoring circuit (6) outputs an indicator of the correct separation of the contacts (2, 3).

10. The switching device as claimed in claim 8 or 9, characterized in that the monitoring circuit (6) is preceded by a rectifier (7).

11. The switching device as claimed in claim 8, 9 or 10, characterized in that the monitoring circuit (6) exhibits a contact voltage indicator (9) and an evaluating unit (10), that the contact voltage indicator (9) outputs to the evaluating unit (10) a preliminary signal (I) corresponding to the contact voltage (U) and that the evaluating unit (10) determines the indicator.

12. The switching device as claimed in claim 11, characterized in that the contact voltage indicator (9) is DC-isolated from the evaluating unit (10).

13. The switching device as claimed in one of claims 9 to 12, characterized in that the monitoring circuit (6) is connected to the bridge drive (5) by control technology.

14. The switching device as claimed in one of claims 7 to 13, characterized in that the monitoring circuit (6) is communicatively connected to a higher-level controller (12).

Abstract

Monitoring method for an electromagnetic switching device and electromagnetic switching device corresponding thereto

An electromagnetic switching device (1) is to be monitored at least for the correct connection of an input contact (2) and of an output contact (3) by a contact bridge (4). For this purpose, a monitoring circuit (6) is coupled to the contacts (2, 3) before the contact bridge (4) is moved into a connection position when a connection command is given and an indicator of the correct connection of the contacts (2, 3) is determined by evaluation of a contact voltage (U) dropped across the contacts (2, 3) and supplied to the monitoring circuit (6).

Figure 1

FIG 1

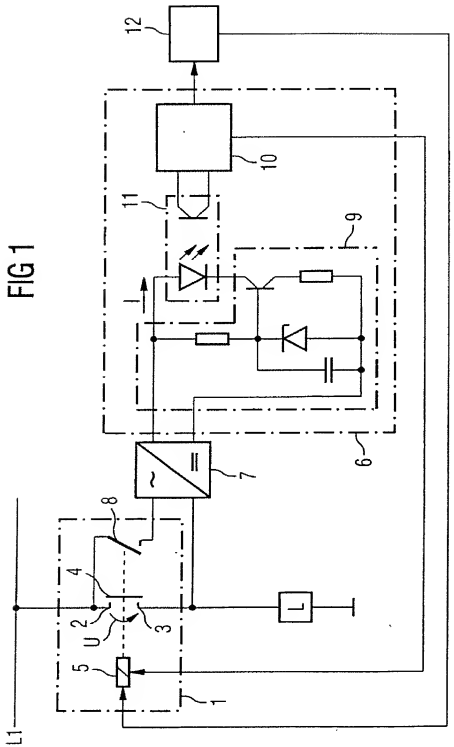


FIG 2

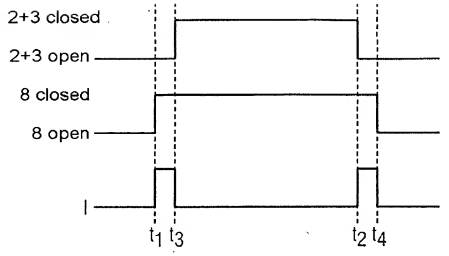


FIG 3

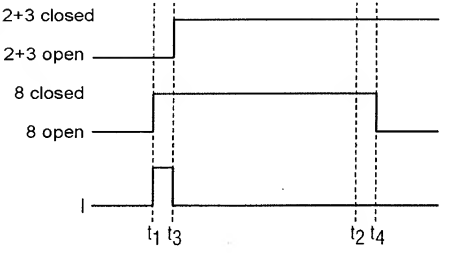
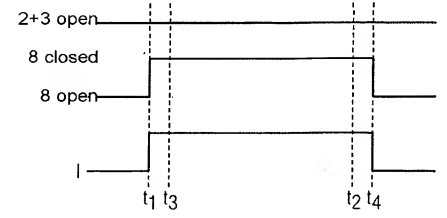


FIG 4



Declaration and Power of Attorney For Patent Application
Erklärung Für Patentanmeldungen Mit Vollmacht
German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

As a below named inventor, I hereby declare that:

dass mein Wohnsitz, meine Postanschrift, und meine Staatsangehörigkeit den im Nachstehenden nach meinem Namen aufgeführten Angaben entsprechen,

My residence, post office address and citizenship are as stated below next to my name,

dass ich, nach bestem Wissen der ursprüngliche, erste und alleinige Erfinder (falls nachstehend nur ein Name angegeben ist) oder ein ursprünglicher, erster und Miterfinder (falls nachstehend mehrere Namen aufgeführt sind) des Gegenstandes bin, für den dieser Antrag gestellt wird und für den ein Patent beantragt wird für die Erfindung mit dem Titel:

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Überwachungsverfahren für ein elektromagnetisches Schaltgerät und hiermit korrespondierendes elektromagnetisches Schaltgerät

CONTROL SYSTEM FOR AN ELECTROMAGNETIC SWITCHING DEVICE AND ELECTROMAGNETIC SWITCHING DEVICE CORRESPONDING THERETO

deren Beschreibung

(zutreffendes ankreuzen)
☐ hier beigefügt ist.
☒ am 31.07.2000 als
PCT internationale Anmeldung
PCT Anmeldungsnummer PCT/DE00/02522
eingereicht wurde und am _____
abgeändert wurde (falls tatsächlich abgeändert).

the specification of which

(check one)
☐ is attached hereto.
☒ was filed on 31.07.2000 as
PCT international application
PCT Application No. PCT/DE00/02522
and was amended on _____
(if applicable)

Ich bestätige hiermit, dass ich den Inhalt der obigen Patentanmeldung einschliesslich der Ansprüche durchgesehen und verstanden habe, die eventuell durch einen Zusatzantrag wie oben erwähnt abgeändert wurde.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment referred to above.

Ich erkenne meine Pflicht zur Offenbarung irgendwelcher Informationen, die für die Prüfung der vorliegenden Anmeldung in Einklang mit Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) von Wichtigkeit sind, an.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

Ich beanspruche hiermit ausländische Prioritätsvorteile gemäss Abschnitt 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 119 aller unten angegebenen Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde, und habe auch alle Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde nachstehend gekennzeichnet, die ein Anmeldedatum haben, das vor dem Anmeldedatum der Anmeldung liegt, für die Priorität beansprucht wird.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

German Language Declaration

Prior foreign applications
Priorität beansprucht

			Priority Claimed	
19944461.7	DE	16.09.1999	☒	☐
(Number) (Nummer)	(Country) (Land)	(Day Month Year Filed) (Tag Monat Jahr eingereicht)	Yes Ja	No Nein
			☐	☐
(Number) (Nummer)	(Country) (Land)	(Day Month Year Filed) (Tag Monat Jahr eingereicht)	Yes Ja	No Nein
			☐	☐
(Number) (Nummer)	(Country) (Land)	(Day Month Year Filed) (Tag Monat Jahr eingereicht)	Yes Ja	No Nein

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozeßordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

I hereby claim the benefit under Title 35. United States Code. §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §122, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occured between the filing date of the prior application and the national or PCT international filing date of this application.

PCT/DE00/02522	31.07.2000		pending
(Application Serial No) (Anmeldeserienummer)	(Filing Date D, M, Y) (Anmeldedatum T, M, J)	(Status) (patentiert, anhangig, aufgegeben)	(Status) (patented, pending, abandoned)
(Application Serial No) (Anmeldeserienummer)	(Filing Date D,M,Y) (Anmeldedatum T, M, J)	(Status) (patentiert, anhangig, aufgeben)	(Status) (patented, pending, abandoned)

Ich erkläre hiermit, dass alle von mir in der vorliegenden Erklärung gemachten Angaben nach meinem besten Wissen und Gewissen der vollen Wahrheit entsprechen, und dass ich diese eidesstattliche Erklärung in Kenntnis dessen abgebe, dass wissentlich und vorsätzlich falsche Angaben gemäss Paragraph 1001, Absatz 18 der Zivilprozessordnung der Vereinigten Staaten von Amerika mit Geldstrafe belegt und/oder Gefängnis bestraft werden koennen, und dass derartig wissentlich und vorsätzlich falsche Angaben die Gültigkeit der vorliegenden Patentanmeldung oder eines darauf erteilten Patentes gefährden können.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

German Language Declaration

VERTRETUNGSVOLLMACHT: Als benannter Erfinder beauftrage ich hiermit den nachstehend benannten Patentanwalt (oder die nachstehend benannten Patentanwälte) und/oder Patent-Agenten mit der Verfolgung der vorliegenden Patentanmeldung sowie mit der Abwicklung aller damit verbundenen Geschäfte vor dem Patent- und Warenzeichenamt: *(Name und Registrationsnummer anführen)*

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

And I hereby appoint

Customer No. 30596

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100

Voller Name des einzigen oder ursprünglichen Erfinders	Full name of sole or first inventor
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Bernhard Streich	Bernhard Streich
Unterschrift des Erfinders Datum	Second inventor's signature Date
	4.2.2008
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(Bitte entsprechende Informationen und Unterschriften im Falle von dritten und weiteren Miterfindern angeben).

(Supply similar information and signature for third and subsequent joint inventors).